

***Team work 1:***  
***EU Emission Targets and Gas***  
***with suggested approach to Task 1***

*PET590 GVC*

*Weeks 4-6 2018*

# *EU Emission Targets and Gas*

## Task 1

The EU has set targets/ambitions for the decarbonization of the European electricity sector, both through the 2050 Roadmap and through the emission cap in the ETS trading sector.

- Find and give an overview of EU emission goals (targets/ambitions) relevant for the power (electricity) sector in 2030
- Assess future predictions of EU power mix, i.e from the IEA (WEO 2012 is freely downloadable), and judge to which degree these imply that EU's emissions goals will be fulfilled
- What options do EU have for achieving these goals in 2030? Propose at least two different pathways and discuss the pros and cons of each.

## Task 2

Gas to coal switch is considered a cost-efficient way of reducing power sector emissions.

- Calculate approximately which CO<sub>2</sub> price will be necessary to make a substitution of coal with gas fired power economically attractive, using current market prices for coal and gas. (Hint: Find typical thermal efficiencies and CO<sub>2</sub> emission factors for coal and gas generators)

- Additional: Please check to see if the numbers I cited are accurate!

# *Housekeeping*

- 20 students are divided into 4 teams.
- Each team will jointly research and solve 2 tasks.
- Each team prepare presentations of 10 – 12 slides with their answers to the questions. Max 20 min per group.
- On Monday 5<sup>th</sup> Feb we will have a team session 13:00 – 15:00 where each team will present their findings in plenum, and we will discuss what we see and learn from these presentations.
- The presentations will be part of the curriculum for this course.
- Co-operation between groups are not appreciated as all have same tasks.
- Suggested sources are attached...on next slide!
- Honor code applies.

# *Some Suggested Sources....*

*But others are also available....!*

## Overview

[https://ec.europa.eu/clima/policies/strategies\\_en](https://ec.europa.eu/clima/policies/strategies_en)

EU's ambitions for 2030 electricity sector emissions, according to Roadmap 2050: 57-65% cuts

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52011DC0885&from=EN>

EU's target for the EU ETS sector in 2030 (NB! Not only power): 43% lower emissions (than in 2005? Or 1990?)

[https://ec.europa.eu/clima/policies/ets\\_en](https://ec.europa.eu/clima/policies/ets_en)

IEA's outlook for 2030, electricity generation mix and emissions (WEO 2015)

<https://www.iea.org/publications/freepublications/publication/WEO2015.pdf>

IEA's 2005 emissions (for reference, p616)

<https://www.iea.org/publications/freepublications/publication/WEO2015.pdf>

## Optional reading

EU's assumption of renewables share in electricity sector: 45% in 2030; information is somewhat hidden

<http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN>

Text: This EU level target will drive continued investment in renewable energy meaning, for example, that the share of renewable energy in the electricity sector would increase from 21% today to at least 45% in 2030.

# *Teams - PET 590 Spring 2018*

- **Team 1**

- Vladislav Volkov (Leader)
- Saeid Abdollahpour
- Saeed Sajedi
- Julie Tanum
- Luis Jose Abaunza

- **Team 2**

- Danny Canas (Leader)
- Jørgen Hersve Thorød
- Linda Monsen
- Baba Nasiru Lawal Junior
- Ofei Michael

- **Team 3**

- Fawzi Chamssine (Leader)
- Anderson Parra Camacho
- Kent Arne Ask
- Obinna Eleri
- Awais Ashraf

- **Team 4**

- Baber Rafique (Leader)
- Yasin Amini Shareza
- Sergey Kim
- Nonso Ihebuzor
- Heidi Søyland

# Suggested approach to Task 1

## Data from WEO 2012

[https://www.iea.org/publications/freepublications/publication/WEO2012\\_free.pdf](https://www.iea.org/publications/freepublications/publication/WEO2012_free.pdf),  
p574

From WEO 2012 p 574, "New Policies" scenario which is IEA's Base Case

### Electricity generation (TWh)

	1990	2005	2010	2015	2020	2025	2030	2035
Coal	1050	1001	862	870	760	628	498	341
Oil	221	139	86	58	43	31	24	21
Gas	191	664	758	660	723	838	903	960
Nuclear	795	998	917	878	845	821	828	830
Renewable	311	473	687	922	1113	1285	1449	1626
Total	2568	3275	3310	3388	3484	3603	3702	3778

Renewable	12 %	21 %	21 %	27 %	32 %	36 %	39 %	43 %
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### Electricity sector emissions (mill tons)

	1990	2005	2010	2015	2020	2025	2030	2035
Coal	1170	992	880	845	736	593	445	310
Oil	195	109	76	55	42	30	23	20
Gas	127	307	347	314	343	381	403	436
Total	1492	1408	1303	1214	1121	1004	871	766
% of 2005	106 %	100 %	93 %	86 %	80 %	71 %	62 %	54 %
CO2 reduc	-6 %	0 %	7 %		Reduction vs 1990	38 %		

Conclusion: IEA's Base Case scenario does not by far meet the 2050 Roadmap's ambitions of 54-68% lower emissions

### Emission factors (calculated from data above) (mill ton/TWh = ton/MWh)

	1990	2005	2010	2015	2020	2025	2030	2035
Coal	1,11	0,99	1,02	0,97	0,97	0,94	0,89	0,91
Oil	0,88	0,78	0,88	0,95	0,98	0,97	0,96	0,95
Gas	0,66	0,46	0,46	0,48	0,47	0,45	0,45	0,45

From WEO 2012

From WEO 2007

Calculated

(2005 data are included because EU ETS emission targets refer to 2005 and not 1990)

# Suggested approach to Task 1

## Replace coal with gas only...!

Electricity generation (TWh)

	1990	2005	2010	2015	2020	2025	2030
Coal	1050						0
Oil	221						24
Gas	191						1401
Nuclear	795						828
Renewables	311						1449
Total	2568						3702

Changes vs reference

Eliminate use of coal  
Increase use of gas

Assumed emission factors

Coal	0,9 ton/MWh
Oil	0,95 ton/MWh
Gas	0,45 ton/MWh

Renewable share 12 % 39 %

Electricity sector emissions (mill tons)

	1990	2015	2015	2015	2020	2025	2030
Coal	1170						0
Oil	195						23
Gas	127						630
Total	1492						653
% of 2005	100 %						44 %
CO2 reduction	0 %				Reduction vs 1990		56 %

Targeted emissions reductions in 2030: 54-68%

**Conclusion: Replacing all coal by gas meets ambitions, but only marginally**

Potential challenges:

Strong (unrealistic?) buildup in gas generation, further cuts may require phaseout of relatively new gas plants

# Suggested approach to Task 1

## Replace coal by renewables...!

Electricity generation (TWh)

	1990	2005	2010	2015	2020	2025	2030
Coal	1050						0
Oil	221						24
Gas	191						903
Nuclear	795						828
Renewables	311						1947
<b>Total</b>	<b>2568</b>						<b>3702</b>

Changes vs reference

Eliminate use of coal

Increase renewables (solar, wind)

Assumed emission factors

Coal	0,9 ton/MWh
Oil	0,95 ton/MWh
Gas	0,45 ton/MWh

Renewable share 12 % 53 %

Electricity sector emissions (mill tons)

	1990	2015	2015	2015	2020	2025	2030
Coal	1170						0
Oil	195						23
Gas	127						406
<b>Total</b>	<b>1492</b>						<b>429</b>
% of 2005	100 %						29 %
CO2 reduction	0 %						71 %

Targeted emissions reductions in 2030: 54-68%

**Conclusion: Replacing all coal by renewables overperforms versus ambitions for 2030**

Potential challenges:

High costs associated with renewables

High renewable share: Is there enough backup capacity?



# Suggested approach to Task 1

## Saving energy and cutting back on coal...!

Change from reference

### Electricity generation (TWh)

	1990	2005	2010	2015	2020	2025	2030
Coal	1050						106
Oil	221						24
Gas	191						903
Nuclear	795						828
Renewables	311						1449
<b>Total</b>	<b>2568</b>						<b>3310</b>

### Changes vs reference

Reduction in use of coal

Same electricity use as in 2010

### Assumed emission factors

Coal	0,9 ton/MWh
Oil	0,95 ton/MWh
Gas	0,45 ton/MWh

Renewable share	12 %	44 %
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### Electricity sector emissions (mill tons)

	1990	2015	2015	2015	2020	2025	2030
Coal	1170						95
Oil	195						23
Gas	127						406
<b>Total</b>	<b>1492</b>						<b>525</b>
% of 2005	100 %						35 %
CO2 reduction	0 %						65 %

Targeted emissions reductions in 2030: 54-68%

**Conclusion: Saving energy and cutting back on coal give emissions well within ambitions for 2030**

Potential challenges:

Challenging to save sufficient energy?